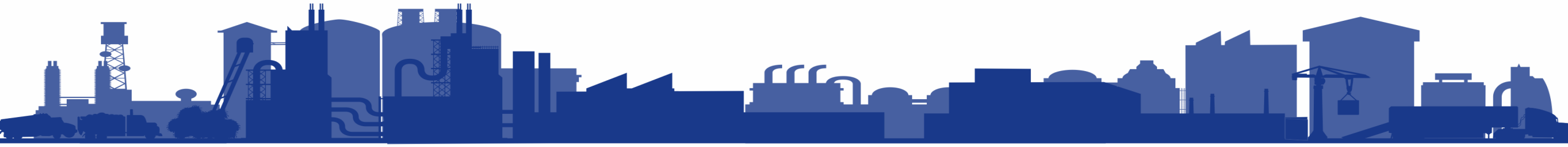
Better Plants
U.S. DEPARTMENT OF ENERGY

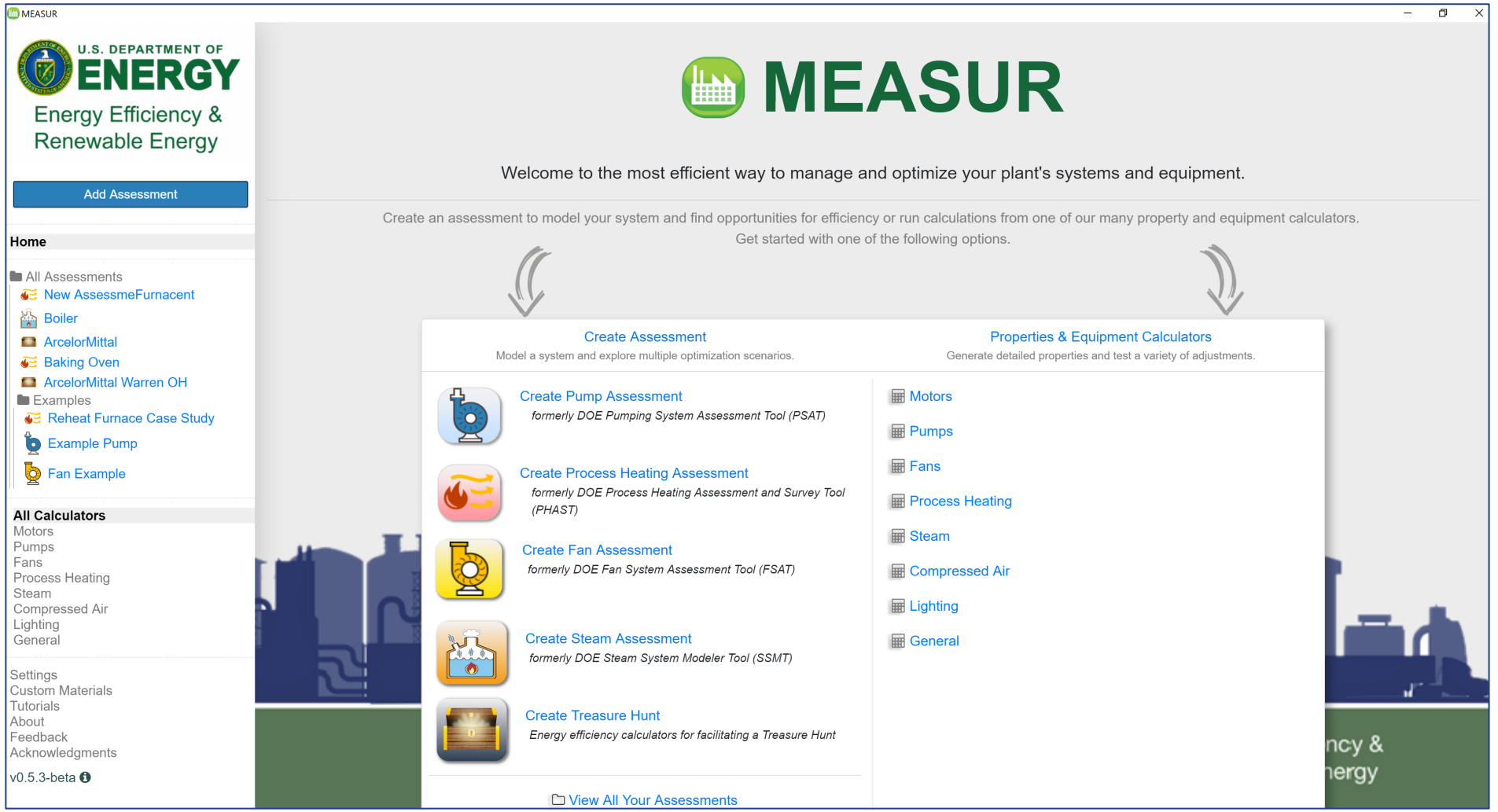
VIRTUAL PROCESS HEATING INPLT
Session 3

U.S. DEPARTMENT OF ENERGY

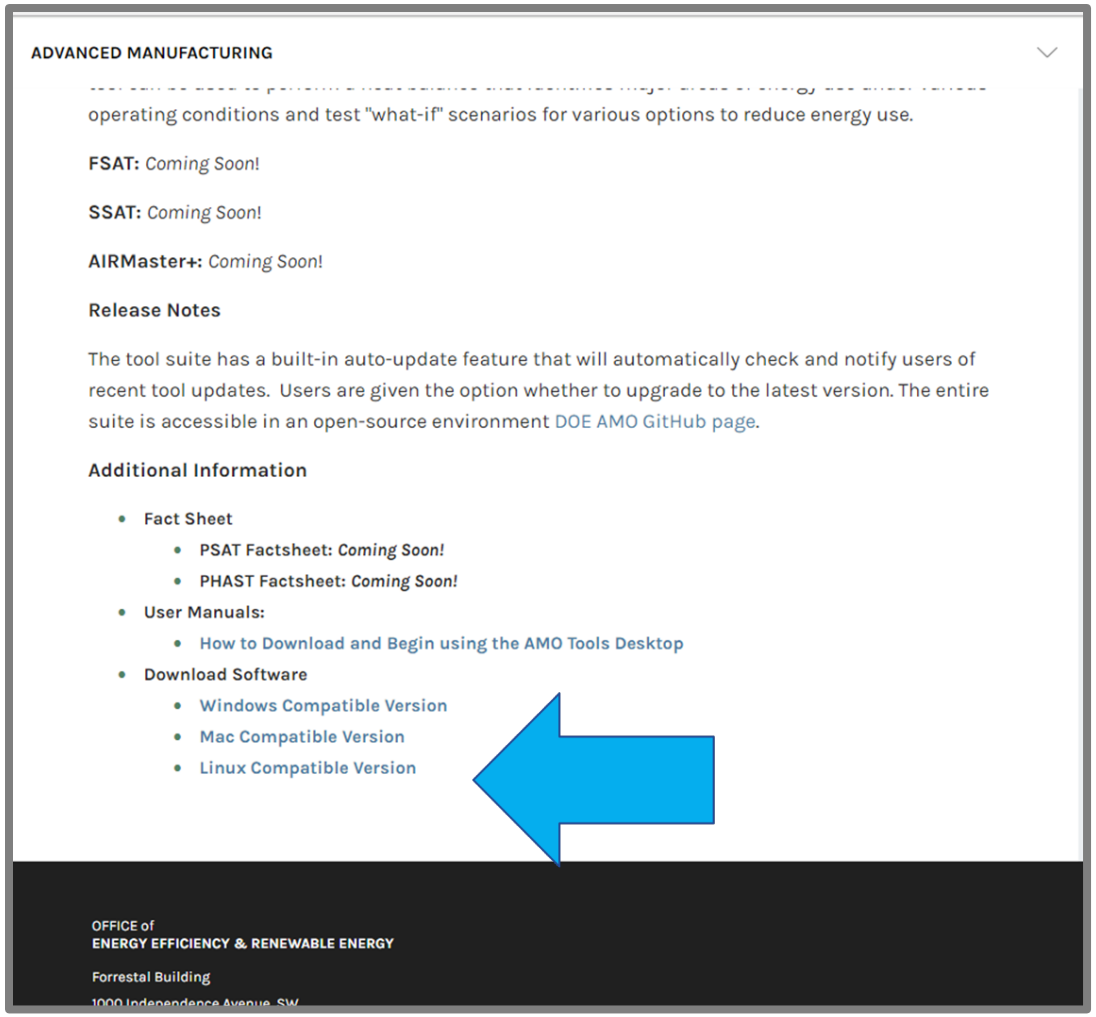
Training Module # 3
MEASUR Software Tools for Process Heating



MEASUR – Process Heating Module

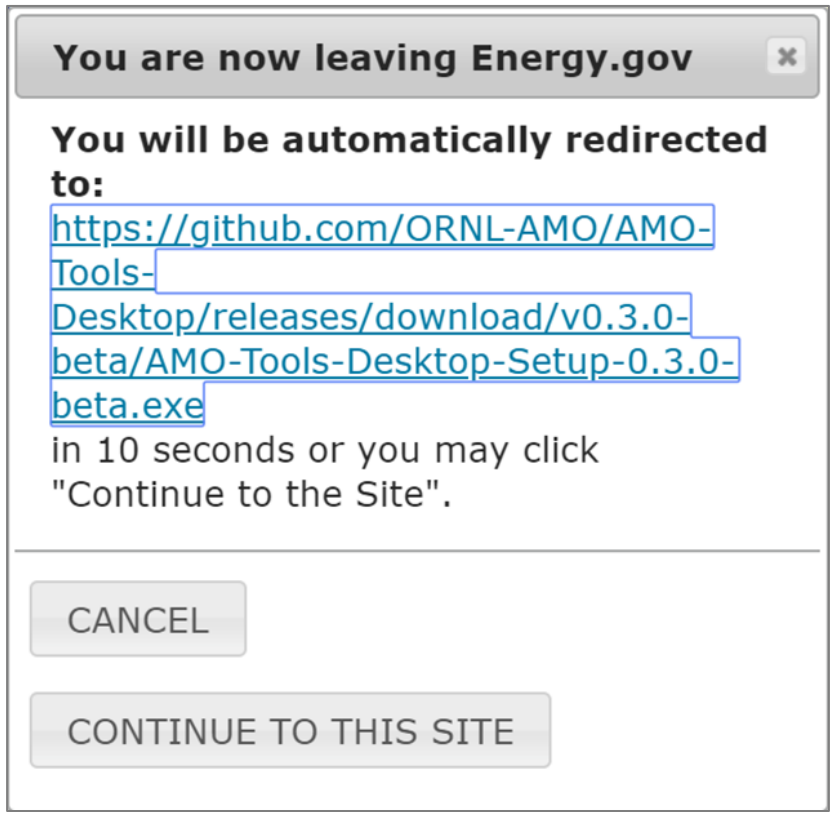


Download via DOE-EERE- AMO website



- https://www.energy.gov/eere/amo/measur
- Includes overview of the effort to reprogram our legacy tools
- Scroll to the bottom to find and download your version

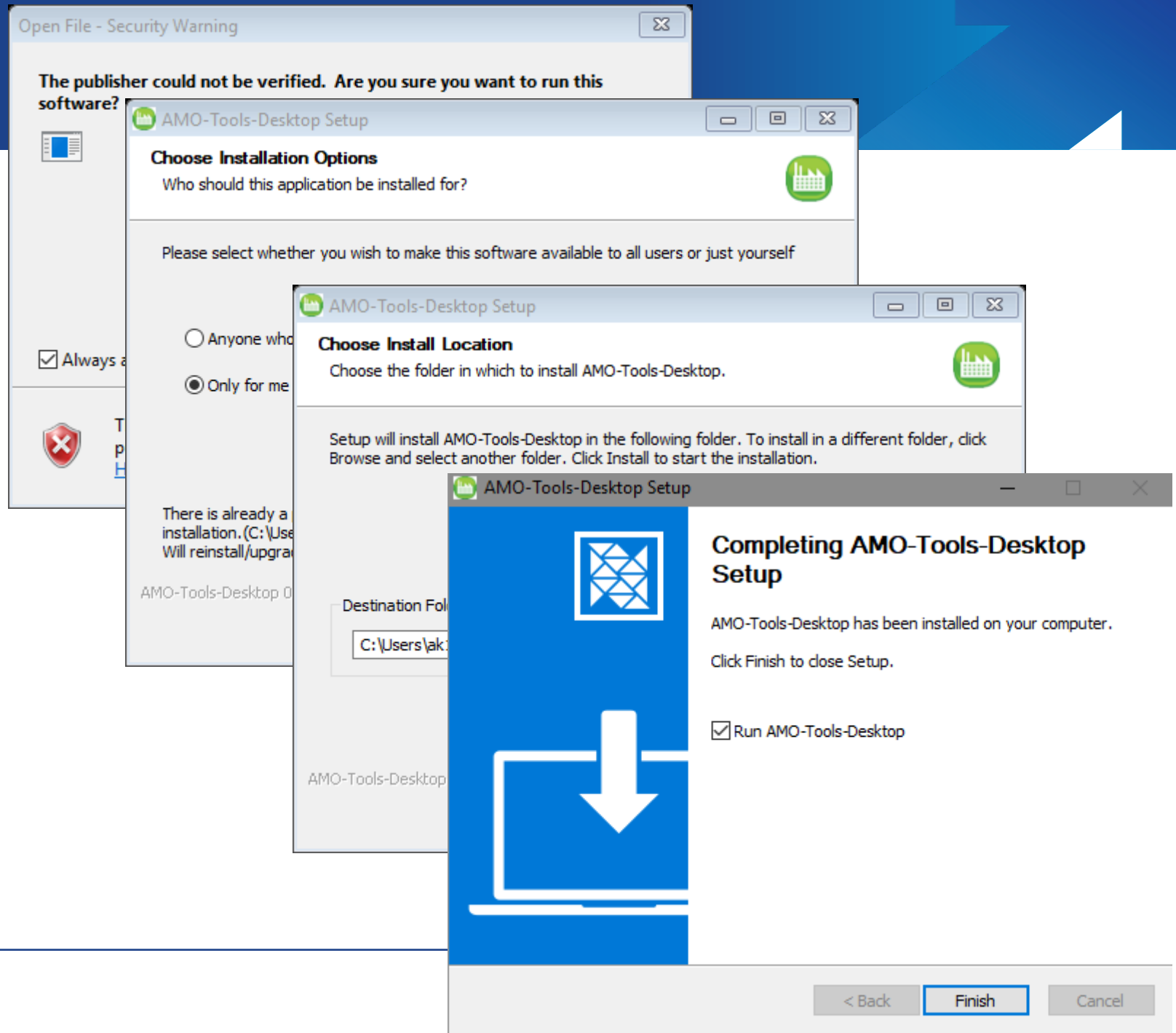
Download via DOE-EERE- AMO website



- This message will appear indicating that the file you are downloading is hosted on another website.
- That web site is GitHub, the common repository for software applications and is perfectly safe.

Download

- Click the file extension that matches your operating system
- Open the download
- Click “Run”
- Follow the instructions for the Installation Wizard
- If updating via the webpage DO NOT uninstall first



Updating

- This Tool is in beta, so we are constantly upgrading it and publishing releases fairly often.
- After installation, if an update becomes available, a popup will appear at startup to notify you.
  - You can choose to update right away, or you can wait.
  - If for some reason this does not happen, you can download from the AMO Tools Download Center
- DO NOT UNINSTALL before updating, you will lose ALL your assessments.

PHASTEx (Excel Version)

Process Heating Assessment and Survey Tool (Excel Version) (PHASTEx v1.01)

PHASTEx - Excel International Version

Developed by E3M Inc. under contract with Oak Ridge National Laboratory

What is PHASTEx?

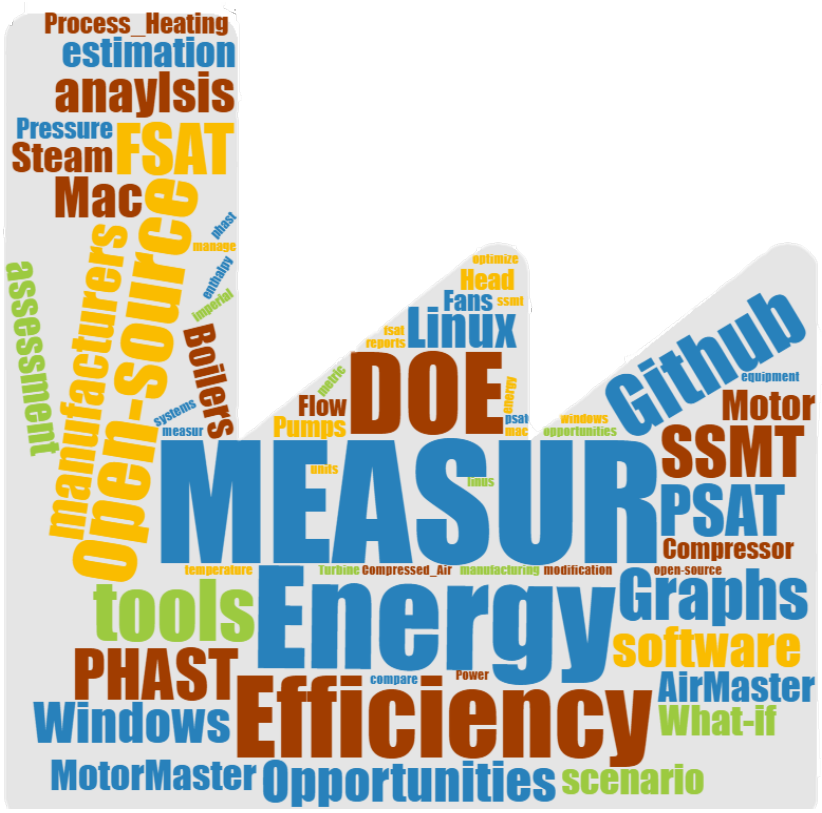
Control Page

PHASTEx_For Excel v1.02.xls

No.	Items	Number of Components	
1	Plant General Information		Enter Data
2	Furnace Data		Enter Data
3.1	Charge material- Solids (wet or dry) Enter "0" if none	3	Enter Data
3.2	Charge material- Liquids Enter "0" if none	3	Enter Data
3.3	Charge material- Gases/vapors Enter "0" if none	3	Enter Data
4	Fixtures, trays, conveyor etc. Enter "0" if none	6	Enter Data
5	Wall surface heat losses	10	Enter Data
6	Water or air cooling (internal) Enter "0" if none	6	Enter Data
7	Atmosphere or makeup air Enter "0" if none	3	Enter Data
8	Flue Gases		Enter Data
9	Radiation losses from openings- Enter "0" if none	6	Enter Data
10	Power use by Electric Motors & Other Devices	10	Enter Data
11	Other heat loss or generation- Enter "0" if none	2	Enter Data
View PHASTEx Summary Report			Go To Report
View PHASTEx Energy Usage Distribution			Go To Report

MEASUR Demo

Using MEASUR



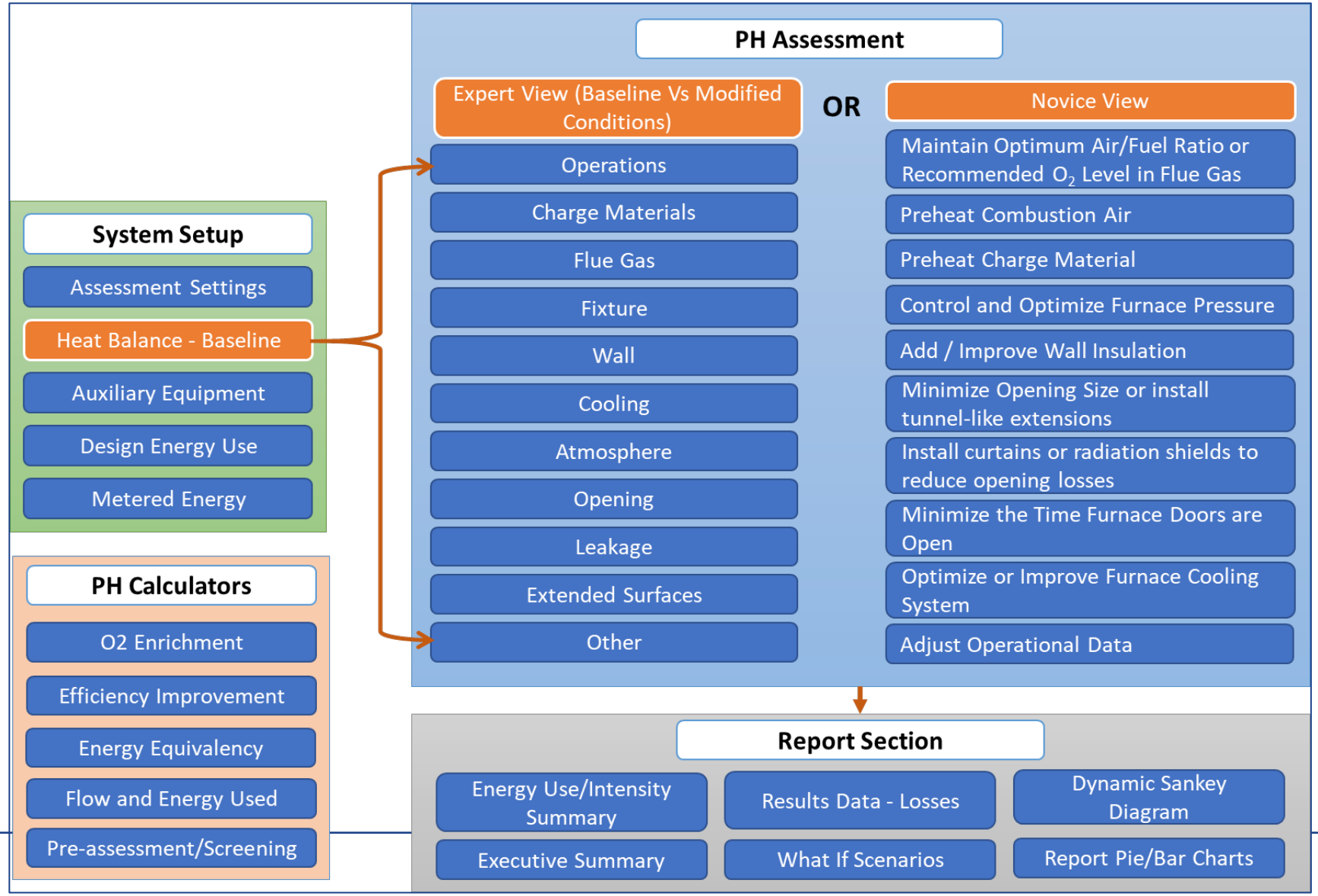
Getting Started

- Start an assessment
- Create an inventory
- View Assessment Dashboard
- Use Properties & Equipment Calculators
- Help and User Experience
  - Change Settings
  - View Tutorials
  - Manage Custom Materials
  - Provide Feedback
  - Translate

MEASUR Process Heating Assessment Module

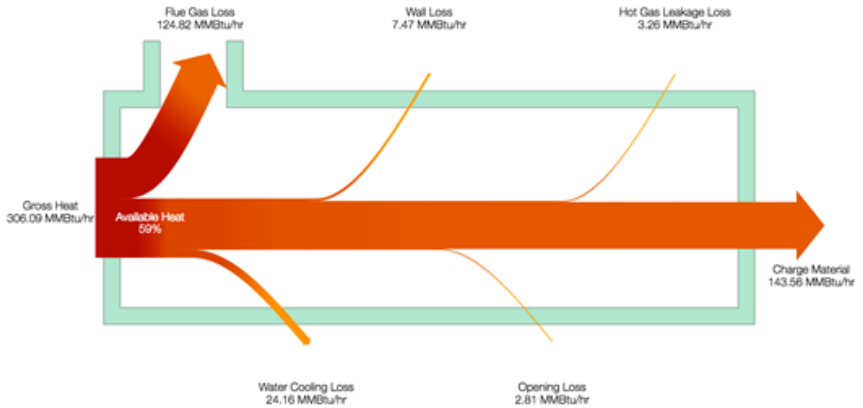
- MEASUR can be used for fuel fired, electric, or steam-based systems as well as hybrid systems
- The user defines the heating system type in the ‘Design Energy Use’ section
- For all heat system types, the user can select English units or international units of measurements
- Assessments can be shared or transferred using MEASUR’s built-in import/export functionality

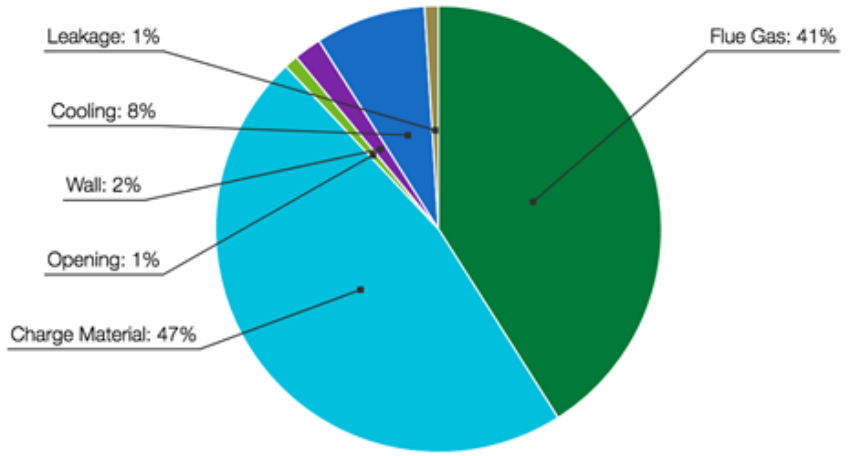
Overview of the MEASUR PH Assessment Module Capabilities



Process Heating System Assessment Tool

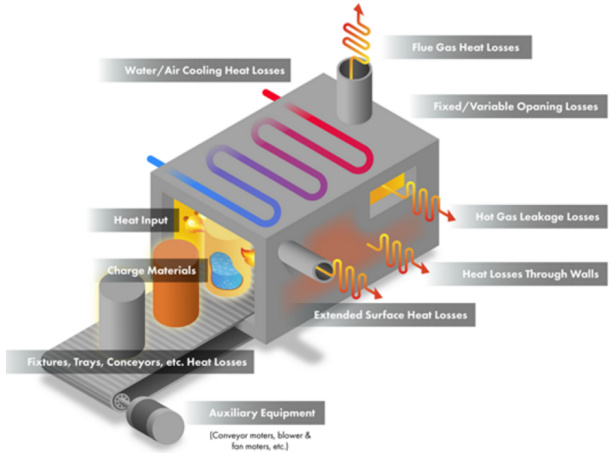
- Models the heat balance for a heating system such as a furnace, oven, boiler, etc.
- The heat balance is based on thermal calculations using simple measurements at several locations on a heating system.
- Allows the user to calculate potential energy savings for the different scenarios
- The results are given in several formats such as pie-charts, static Sankey Diagram, tables, etc.





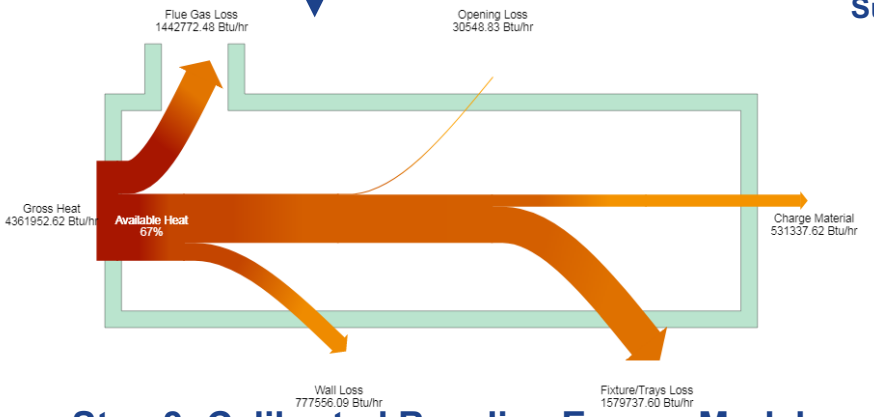
Energy Modeling using MEASUR

Step 1: Data Collection

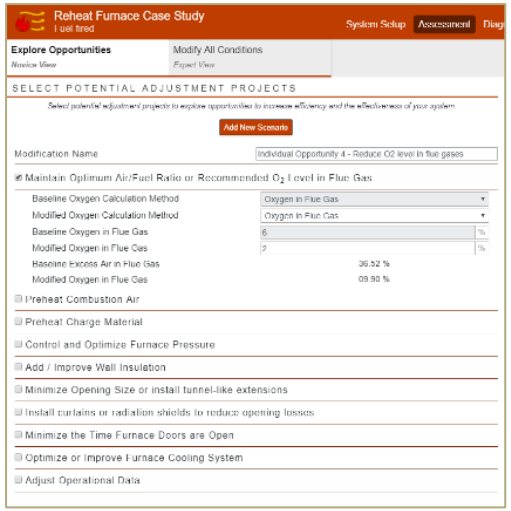


Step 2: Determine the Energy Losses from different Components

Sub-Metered or Design data to verify energy model

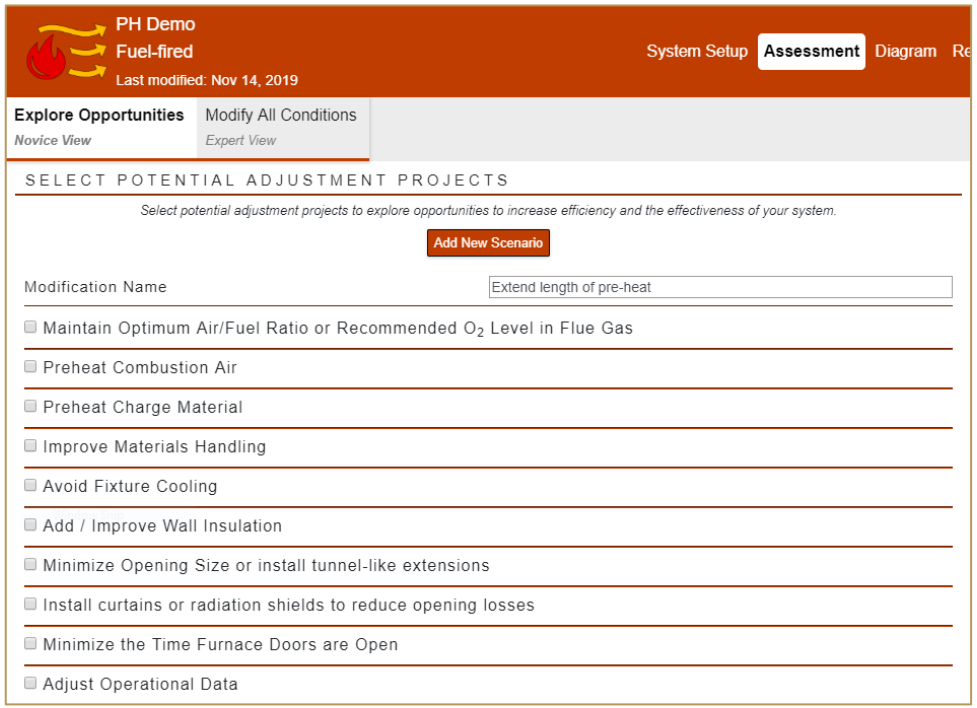


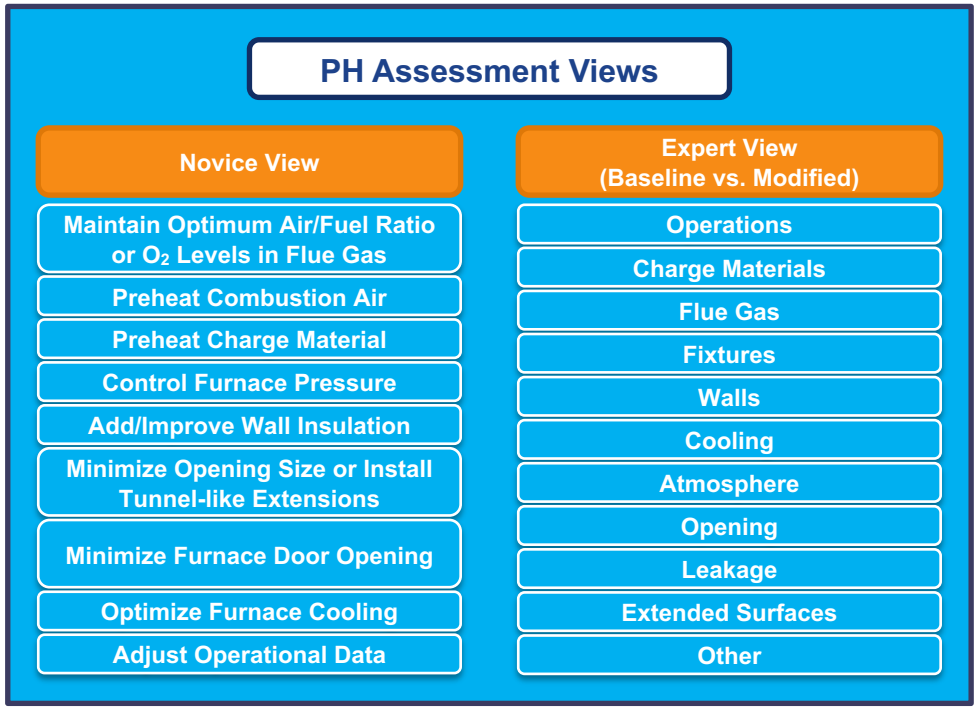
Step 3: Calibrated Baseline Energy Model



Step 4: "What if" analysis to identify and quantify savings opportunity

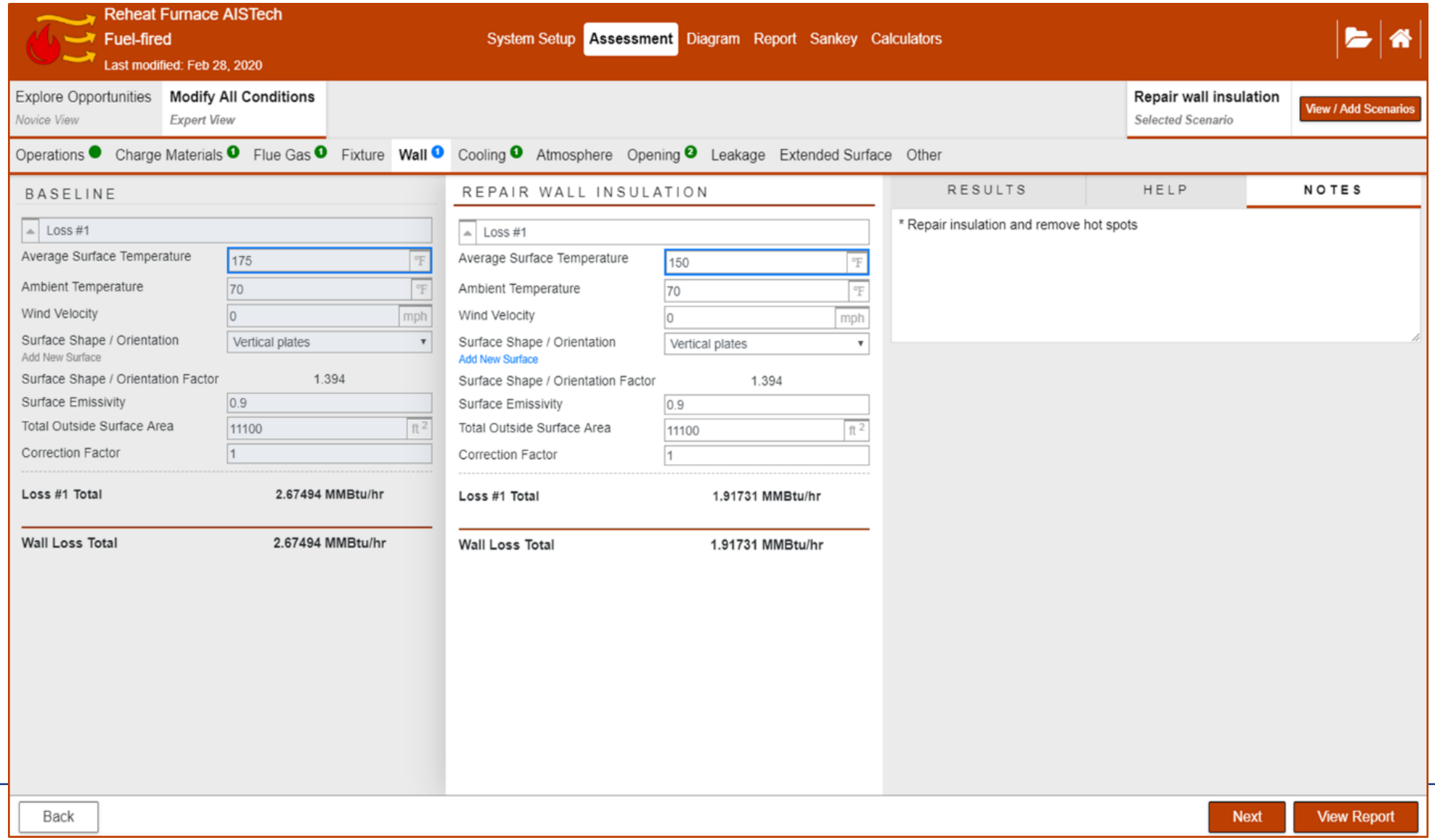
Energy Assessment using MEASUR



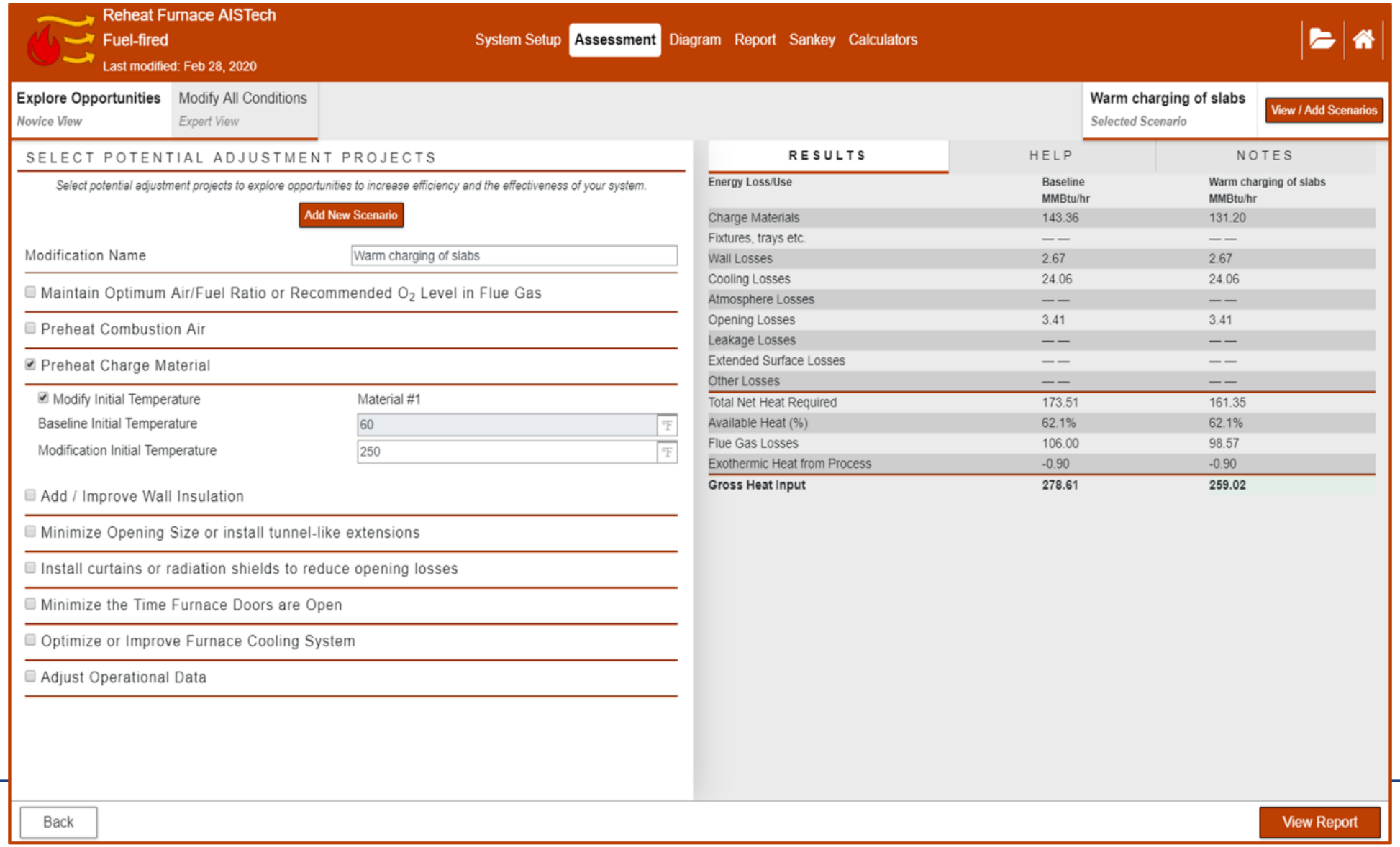


- Explore Opportunities: build scenarios from pre-established energy savings measures
- Modify All Conditions: build scenarios using same form as baseline

e.g. Reheat Furnace Assessment—Expert View with notes



e.g. Reheat Furnace Assessment—Novice View with results



Reheat Furnace Results—Executive Summary

Reheat Furnace AISTech

Fuel-fired

Last Modified Feb 28, 2020, 12:40:23 PM

Print | Export to CSV

Energy Used | **Executive Summary** | Result Data | Report Graphs | Sankey | Input Summary | Facility Info

	Baseline	Warm charging of slabs	Improved cooling insulation	Repair wall insulation	Monitor air/fuel ratio	Preheat combustion air	Extend preheat zone	Combined Opportunities
Percent Savings (%)	— —	7.0%	3.0%	— —	3.0%	2.0%	8.0%	21.0%
Energy Intensity (Btu/lb)	696.53	647.56	674.17	693.48	675.74	682.49	638.15	548.51
Annual Energy Used (MMBtu/yr)	1,925,800	1,790,400	1,863,900	1,917,300	1,868,300	1,886,900	1,764,300	1,516,500
Annual Energy Savings (MMBtu/yr)	— —	135,400	61,832	8,435.9	57,483	38,828	161,420	409,240
Annual Cost	$8,107,465	$7,537,443	$7,847,153	$8,071,949	$7,865,460	$7,943,998	$7,427,904	$6,384,549
Annual Cost Savings	— —	$570,022	$260,312	$35,515	$242,004	$163,467	$679,560	$1,722,915
Implementation Costs	— —	— —	— —	— —	— —	— —	— —	— —
Simple Payback Period (months)	— —	— —	— —	— —	— —	— —	— —	— —

Modification Notes

Warm charging of slabs — Charge Materials: * Hot/warm charging of slabs * Charge end vestibule addition to extend furnace heating length * Increase hearth coverage

Improved cooling insulation — Cooling Losses: * Low conductivity skid insulation

Repair wall insulation — Wall Losses: * Repair insulation and remove hot spots

Monitor air/fuel ratio — Flue Gas Losses: * Atmosphere monitoring/control of zone air/fuel ratio * Trip O2 level to 2%.

Preheat combustion air — Flue Gas Losses: * Increase combustion air preheat temperature (850 degree F to 900 degree F.)

Extend preheat zone — Flue Gas Losses: ** Please note – furnace flue gas temperature drops from 1800 degree F to 1600 degree F due to extended furnace heating length for preheating the charge material.

Reheat Furnace Results Data

Reheat Furnace AISTech

Fuel-fired

Last Modified Feb 28, 2020, 12:40:23 PM

Print | Export to CSV

Energy Used | Executive Summary | **Result Data** | Report Graphs | Sankey | Input Summary | Facility Info

Energy Loss/Use	Baseline MMBtu/hr	Warm charging of slabs MMBtu/hr	Improved cooling insulation MMBtu/hr	Repair wall insulation MMBtu/hr	Monitor air/fuel ratio MMBtu/hr	Preheat combustion air MMBtu/hr	Extend preheat zone MMBtu/hr	Combined Opportunities MMBtu/hr
Charge Materials	143.36	131.20	143.36	143.36	143.36	143.36	143.36	131.20
Fixtures, trays etc.	— —	— —	— —	— —	— —	— —	— —	— —
Wall Losses	2.67	2.67	2.67	1.92	2.67	2.67	2.67	1.92
Cooling Losses	24.06	24.06	18.51	24.06	24.06	24.06	24.06	18.51
Atmosphere Losses	— —	— —	— —	— —	— —	— —	— —	— —
Opening Losses	3.41	3.41	3.41	3.41	3.41	3.41	3.41	3.41
Leakage Losses	— —	— —	— —	— —	— —	— —	— —	— —
Extended Surface Losses	— —	— —	— —	— —	— —	— —	— —	— —
Other Losses	— —	— —	— —	— —	— —	— —	— —	— —
Total Net Heat Required	173.51	161.35	167.96	172.75	173.51	173.51	173.51	155.04
Available Heat (%)	62.1%	62.1%	62.1%	62.1%	64.0%	63.3%	67.7%	70.4%
Flue Gas Losses	106.00	98.57	102.61	105.54	97.68	100.38	82.65	65.26
Exothermic Heat from Process	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90
Gross Heat Input	**278.61**	**259.02**	**269.67**	**277.39**	**270.30**	**272.99**	**255.26**	**219.40**

Reheat Furnace Results—Executive Summary

All Assessments /

Reheat Furnace AISTech

Fuel-fired

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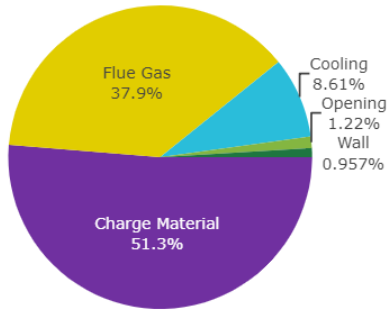
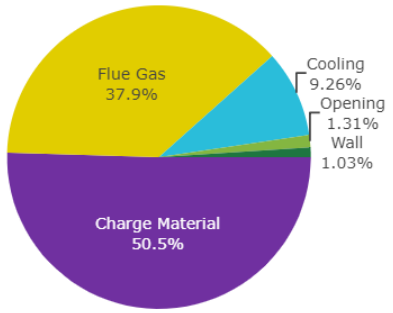
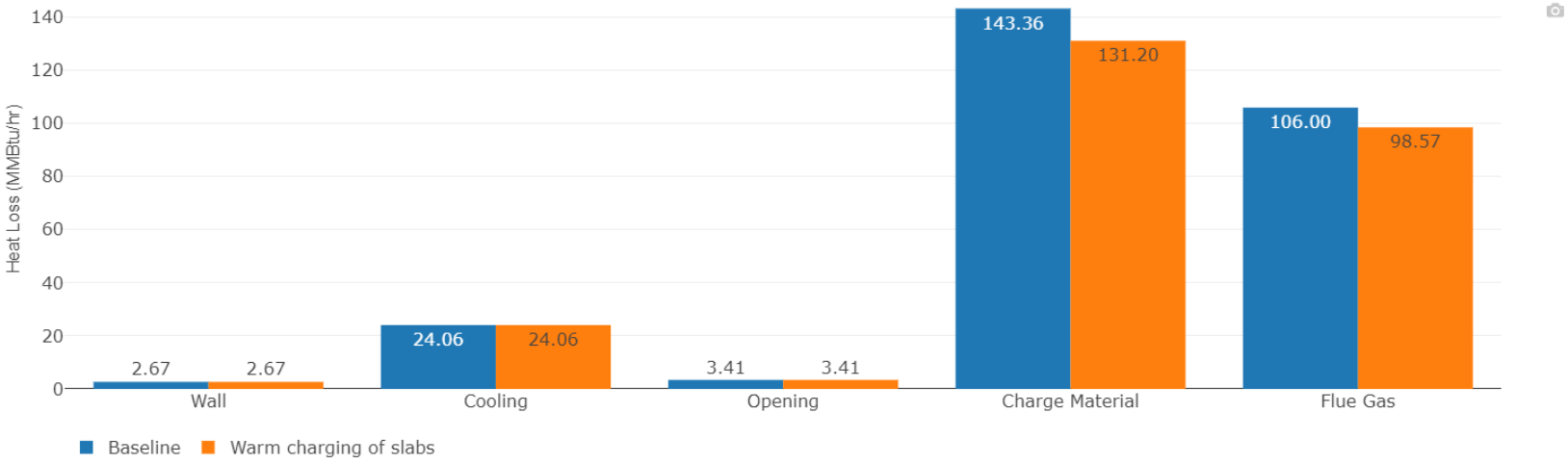
Print | Export to CSV

Energy Used | Executive Summary | Result Data | **Report Graphs** | Sankey | Input Summary | Facility Info







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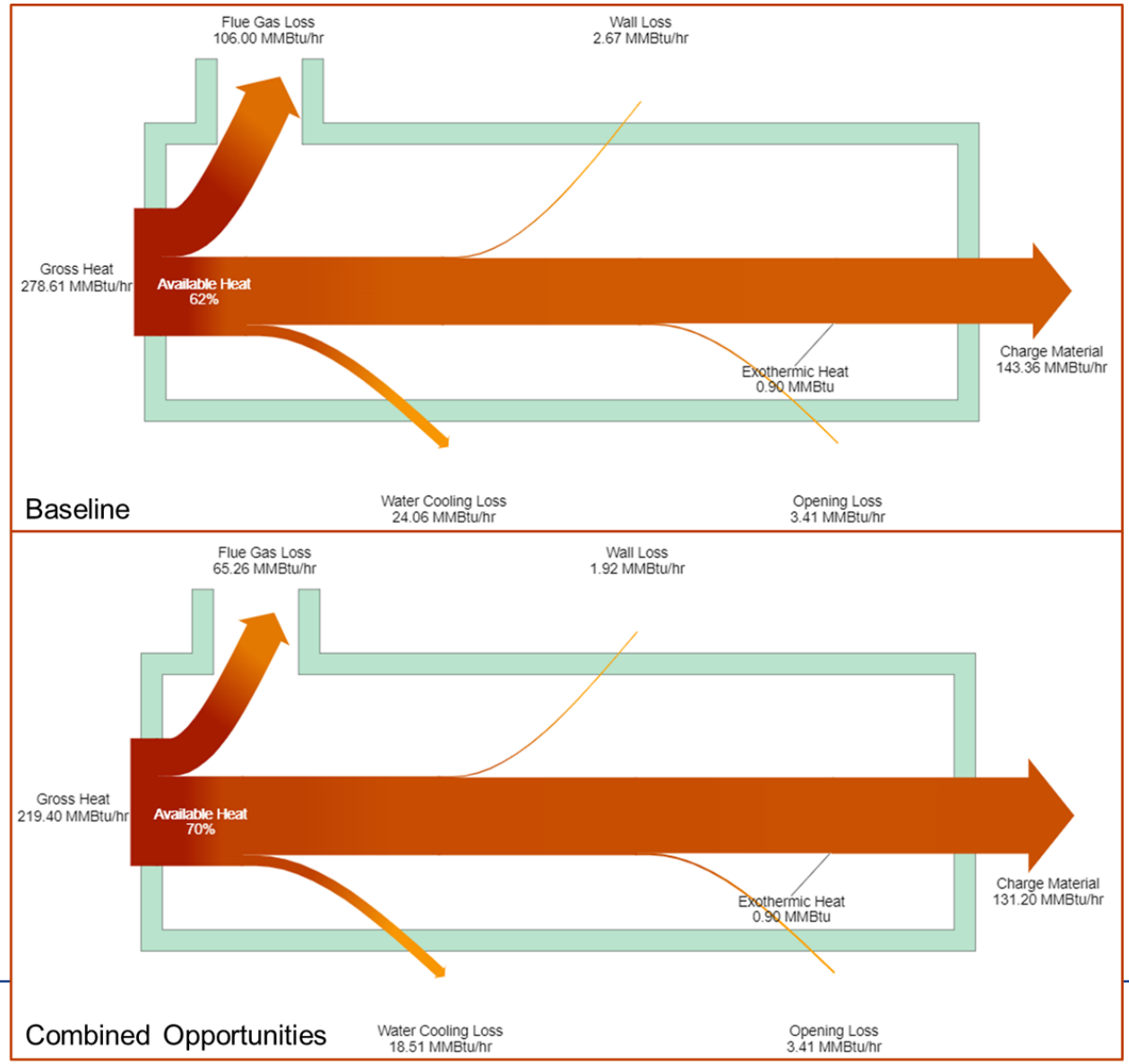
Reheat Furnace Results—Sankey diagrams



Measurements and Diagnostic Equipment

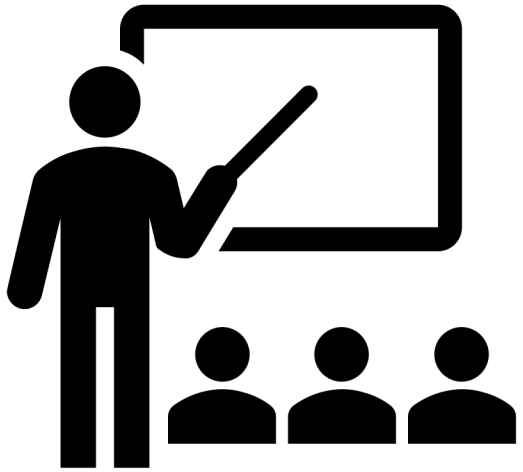
- Combustion Measurement
  - Combustion Analyzer
  - Combustion Efficiency
  - O_2, CO, CO_2
  - Inlet Temperature, Flue, Temperature, Draft, Excess Air
- Surface Heat Loss
  - Temperature

Technical Assistance: Diagnostic Equipment Program

Field data is best for evaluating system performance

- Free of charge, including shipping
- Use equipment for one day, or up to four weeks
- Some technical assistance with selection and usage
- First come, first serve application

Website link - [The Diagnostic Equipment Program]



MEASUR Process Heating Assessment Demonstration

Acknowledgements

Process Heating and Steam System Subject Matter Experts

- Arvind Thekdi, E3M, Inc.
  - Developed the previous versions of PHAST and contributed algorithms to the newer version of PHAST
- Greg Harrell, Milligan College
  - Developed the previous versions of DOE steam tools and continued to contribute to MEASUR by providing feedback
- Glenn Cunningham, Tennessee Technical University
  - Reviewed and provided feedback for the Pump, Fan, and Steam modules, as well as many calculators
- Riyaz Papar, Hudson Tech
  - Reviewed and provided feedback for the Steam module

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